

# PATENT COOPERATION TREATY

# PCT


## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 29 APR 2005

WIPO

|  |   |   |                      |
|--|---|---|----------------------|
| Applicant's or agent's file reference<br><b>P32391ACCI/GMU</b>   | <b>FOR FURTHER ACTION</b>                                       |   | See Form PCT/PEA/416 |
| International application No.<br><b>PCT/GB2004/001443</b>  | International filing date (day/month/year)<br><b>02.04.2004</b> | Priority date (day/month/year)<br><b>04.04.2003</b>                               |                      |
| International Patent Classification (IPC) or national classification and IPC<br><b>F03B13/20</b>   |   |   |                      |
| Applicant<br><b>OCEAN POWER DELIVERY LIMITED et al.</b>  |   |   |                      |
| 1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.<br>2. This REPORT consists of a total of 5 sheets, including this cover sheet.<br>3. This report is also accompanied by ANNEXES, comprising:<br>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 11 sheets, as follows:<br><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).<br><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.<br>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions). |   |   |                      |
| 4. This report contains indications relating to the following items:<br><input checked="" type="checkbox"/> Box No. I      Basis of the opinion<br><input type="checkbox"/> Box No. II     Priority<br><input type="checkbox"/> Box No. III    Non-establishment of opinion with regard to novelty, inventive step and industrial applicability<br><input type="checkbox"/> Box No. IV    Lack of unity of invention<br><input checked="" type="checkbox"/> Box No. V     Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement<br><input type="checkbox"/> Box No. VI    Certain documents cited<br><input type="checkbox"/> Box No. VII   Certain defects in the international application<br><input type="checkbox"/> Box No. VIII  Certain observations on the international application   |   |   |                      |
| Date of submission of the demand<br><br><b>04.02.2005</b>  |   | Date of completion of this report<br><br><b>02.05.2005</b>                        |                      |
| Name and mailing address of the international preliminary examining authority:<br><br> European Patent Office - P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk - Pays Bas<br>Tel. +31 70 340 - 2040 Tx: 31 651 epo nl<br>Fax: +31 70 340 - 3016  |   | Authorized Officer<br><br><b>de Rooij, M</b><br><br>Telephone No. +31 70 340-2306 |                      |



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/001443

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-29 as originally filed

**Claims, Numbers**

1-34 filed with telefax on 18.02.2005

**Drawings, Sheets**

2/12-5/12, 8/12-12/12 as originally filed

1/12, 6/12, 7/12 filed with telefax on 18.02.2005

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/001443

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

|                               |             |      |
|-------------------------------|-------------|------|
| Novelty (N)                   | Yes: Claims | 1-34 |
|                               | No: Claims  |      |
| Inventive step (IS)           | Yes: Claims | 1-34 |
|                               | No: Claims  |      |
| Industrial applicability (IA) | Yes: Claims | 1-34 |
|                               | No: Claims  |      |

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1: US-B1-6 476 511 (PIZER DAVID ET AL) 5 November 2002

2. The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):

A wave power apparatus comprising:

a plurality of buoyant elongate body members, adjacent pairs of body members being interconnected to form an articulated chain, each body member of said pair being connected by linkage means permitting relative rotation of the body member;

power extraction means adapted to resist and extract power from the relative rotation within the linkage means;

wherein the linkage means at the one end of a first body member permit relative rotation about a first axis of rotation and the linkage means at a second end of the first body member permit relative rotation about a second axis of rotation.

3. The subject-matter of claim 1 differs from this known wave power apparatus in that adjacent pairs of body members are interconnected by a linkage unit and the power extraction means are located substantially within this linkage unit.

4. The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

5. The problem to be solved by the present invention may be regarded as to simplify manufacture, transportation and testing of the wave power apparatus.

6. The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

Manufacturing separate linkage units between each body member requires significant non-obvious structural changes to the body members and also a different working principle of

the apparatus. The body members do not move relative to each other, rather they move relative to linkage units between the body members.

By providing these separate linkage units, the apparatus can be assembled on site, and testing of the power extraction means only requires the linkage units, not all the body members.

7. The same reasoning applies, mutatis mutandis, to the subject-matter of independent claims 21, 31 and 32, which are therefore also considered new and inventive (Article 33(2) and 33(3) PCT).

8. Claims 2-20, 22-30, 33 and 34 are dependent on at least one of the claims 1, 21, 33 and 34 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

1     Claims

2

3     1. Wave power apparatus comprising:

4

5             a plurality of buoyant elongate body  
6             members, at least one adjacent pair of body  
7             members being interconnected by a linkage unit  
8             to form an articulated chain, each body member  
9             of said pair being connected to the respective  
10            linkage unit by linkage means permitting  
11            relative rotation of the body members;

12

13            power extraction means adapted to resist  
14            and extract power from the relative rotation,  
15            the power extraction means being located  
16            substantially within each linkage unit; and

17

18            wherein each linkage unit is arranged to  
19            permit relative rotation between the linkage  
20            unit and a first body member about a first axis  
21            of rotation at a first end of the linkage unit,  
22            and to permit relative rotation between the  
23            linkage unit and a second body member about a  
24            second axis of rotation at a second end of the  
25            linkage unit.

26

27     2. Apparatus as claimed in claim 1, wherein the body  
28     members are arranged consecutively in an articulated  
29     apparatus, each adjacent pair of body members being  
30     interconnected by a linkage unit to form an  
31     articulated chain.

32

- 1     3. Apparatus as claimed in claim 1 or 2, wherein the  
2     or each linkage unit has a longitudinal length  
3     substantially shorter than the body members.  
4
- 5     4. Apparatus as claimed in any preceding claim, in  
6     which the body members substantially comprise hollow  
7     members devoid of active components.  
8
- 9     5. Apparatus as claimed in any preceding claim,  
10    wherein each body member has one or more end caps  
11    with corresponding linkage means to marry with the  
12    linkage means of the linkage unit.  
13
- 14    6. Apparatus as claimed in any preceding claim,  
15    wherein the power extraction means includes a  
16    hydraulic ram assembly.  
17
- 18    7. Apparatus as claimed in claim 6, wherein the  
19    hydraulic ram assembly comprises a plurality of  
20    rams.  
21
- 22    8. Apparatus as claimed in claim 6 or 7, wherein the  
23    power extraction means includes a hydraulic ram  
24    assembly for each axis of rotation.  
25
- 26    9. Apparatus as claimed in claim 8, wherein the  
27    power extraction means includes two hydraulic ram  
28    assemblies acting about each axis of rotation.  
29
- 30    10. Apparatus as claimed in claim 5, wherein the end  
31    caps have a number of cavities to receive respective  
32    ends of the power extraction means.

1

2 11. Apparatus as claimed in any preceding claim,  
3 wherein the power extraction means has at least one  
4 seal to prevent ingress of water into the linkage  
5 unit and/or body members.

6

7 12. Apparatus as claimed in any preceding claim,  
8 wherein the linkage unit includes one or more power  
9 generation or storage means connected to one or more  
10 of the power extraction means.

11

12 13. Apparatus as claimed in claim 12, wherein the  
13 linkage unit includes a first power generation means  
14 connected to one or more power extraction means at  
15 one axis of rotation, and a second power generation  
16 means connected to one or more power extraction  
17 means at the other axis of rotation.

18

19 14. Apparatus as claimed in claim 13, wherein the  
20 first or second power generation means is  
21 connectable to at least one power extraction means  
22 from each axis of rotation, such that the restraint  
23 of the linkage unit is maintained in the event of  
24 failure of one of the power extraction or generation  
25 means.

26

27 15. Apparatus as claimed in claim 13, wherein the  
28 first and second power generation means is  
29 connectable to one or more of the power extraction  
30 means from one or both axes of rotation, such that  
31 when the apparatus is operating at partial capacity,  
32 the one or more power extraction means is connected



1 solely to the first or second power generation  
2 means.

3  
4 16. Apparatus as claimed in any preceding claim,  
5 wherein constraint is applied to each power  
6 extraction means of the linkage unit in order to  
7 induce a cross-coupled response which may be tuned  
8 to be resonant in small waves to increase power  
9 capture and which may be set in large waves to limit  
10 power absorption and maximise survivability.

11  
12 17. Apparatus as claimed in any preceding claim,  
13 wherein the apparatus includes one or more of a  
14 ballasting system, mooring system, and means to  
15 apply a roll bias angle to the axes of rotation.

16  
17 18. Apparatus as claimed in any preceding claim,  
18 wherein the linkage unit includes access means, such  
19 as one or more hatches, to allow inspection, repair  
20 and maintenance on or off site.

21  
22 19. A linkage unit for use in the apparatus of claim  
23 1, comprising:

24  
25 linkage means for interconnection between  
26 the body members permitting relative rotation  
27 at either end of the unit;

28  
29 power extraction means adapted to resist  
30 and extract power from the relative rotation of  
31 the body members;

32

1           the power extraction means being located  
2           substantially within the linkage unit; and

3  
4           wherein the linkage unit is arranged to  
5           permit relative rotation between the linkage  
6           unit and a first body member about a first axis  
7           of rotation at a first end of the linkage unit,  
8           and to permit relative rotation between the  
9           linkage unit and a second body member about a  
10          second axis of rotation at a second end of the  
11          linkage unit.

12  
13       20. A linkage unit as claimed in claim 19, wherein  
14       the power extraction means includes a hydraulic ram  
15       assembly.

16  
17       21. Apparatus as claimed in claim 20, wherein the  
18       hydraulic ram assembly comprises a plurality of  
19       rams.

20  
21       22. A linkage unit as claimed in claim 21, wherein  
22       the power extraction means includes a hydraulic ram  
23       assembly for each axis of rotation.

24  
25       23. A linkage unit as claimed in claim 22, wherein  
26       the power extraction means includes two hydraulic  
27       ram assemblies acting about each axis of rotation.

28  
29       24. A linkage unit as claimed in any of claims 19 to  
30       23, wherein the power extraction means has at least  
31       one seal to prevent ingress of water into the  
32       linkage unit and/or body members.

1

2 25. A linkage unit as claimed in any of claims 19 to  
3 24, wherein the linkage unit includes one or more  
4 power generation or storage means connected to one  
5 or more of the power extraction means.

6

7 26. A linkage unit as claimed in claim 25, wherein  
8 the linkage unit includes a first power generation  
9 means connected to one or more power extraction  
10 means at one axis of rotation, and a second power  
11 generation means connected to one or more power  
12 extraction means at the other axis of rotation.

13

14 27. A linkage unit as claimed in claim 26, wherein  
15 the first or second power generation means is  
16 connectable to at least one power extraction means  
17 from each axis of rotation, such that the restraint  
18 of the linkage unit is maintained in the event of  
19 failure of one of the power extraction or generation  
20 means.

21

22 28. A linkage unit as claimed in claim 27, wherein  
23 the first and second power generation means is  
24 connectable to one or more of the power extraction  
25 means from one or both axes of rotation, such that  
26 when the apparatus is operating at partial capacity,  
27 the one or more power extraction means is connected  
28 solely to the first or second power generation  
29 means.

30

31 29. A linkage unit as claimed in any of claims 19 to  
32 28, wherein constraint is applied to each power

1 extraction means of the linkage unit in order to  
2 induce a cross-coupled response which may be tuned  
3 to be resonant in small waves to increase power  
4 capture and which may be set in large waves to limit  
5 power absorption and maximise survivability.

6  
7 30. A linkage unit as claimed in any of claims 19 to  
8 29, including access means, such as one or more  
9 hatches, to allow inspection, repair and maintenance  
10 on site.

11  
12 31. A method of extracting power from waves  
13 comprising the steps of:

14  
15           deploying an apparatus as claimed in any  
16           of claims 1 to 18;  
17  
18           orientating the structure such that a front end  
19           of the structure faces into the oncoming waves;  
20           and

21  
22           extracting the power absorbed in the or each  
23           linkage unit.

24  
25 32. A method of manufacture of apparatus according  
26 to claims 1 to 18, comprising the step of:

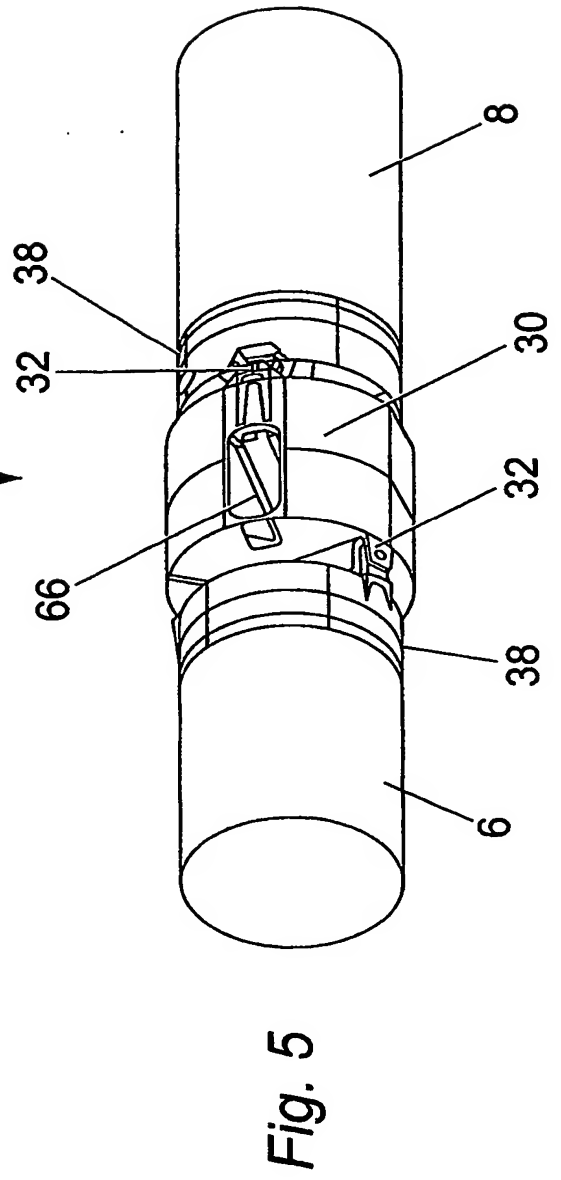
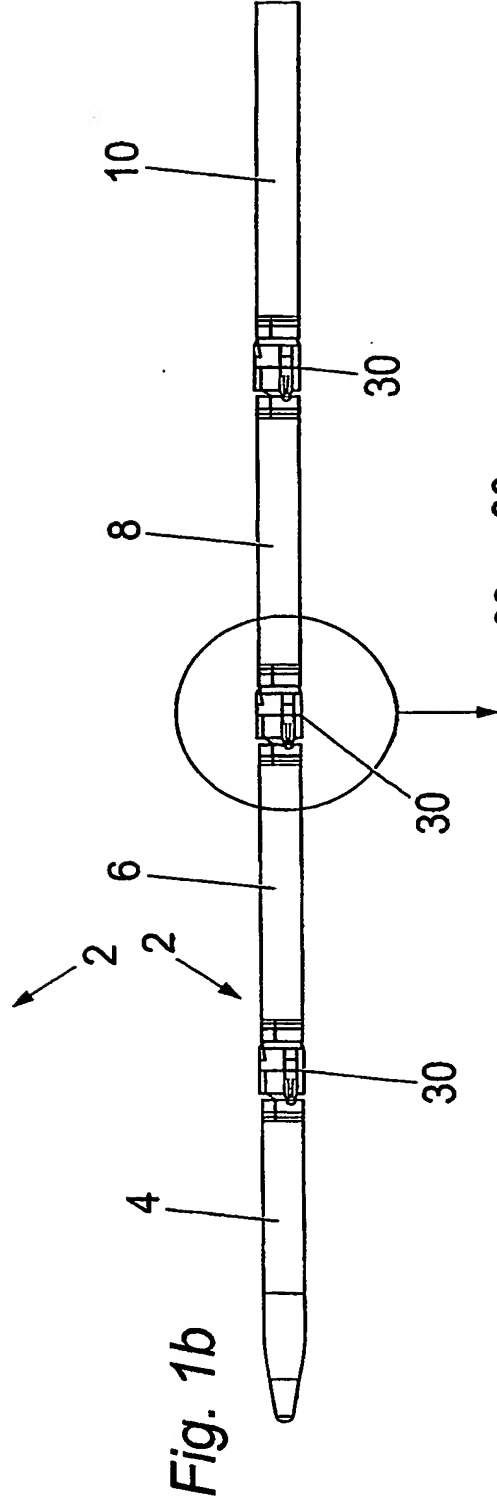
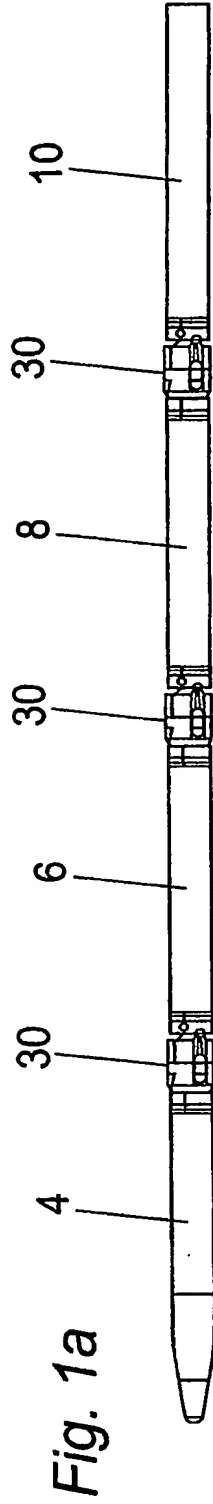
27  
28           interconnecting each pair of adjacent body  
29           members of the apparatus with a linkage unit  
30           according to claims 19 to 30.

31

1 33. The method of claim 32, wherein the body members  
2 and linkage unit(s) are connected together close to  
3 or on site.

4

5 34. The method of claim 32, wherein the linkage  
6 unit(s) are fully assembled and tested before being  
7 transported to site.



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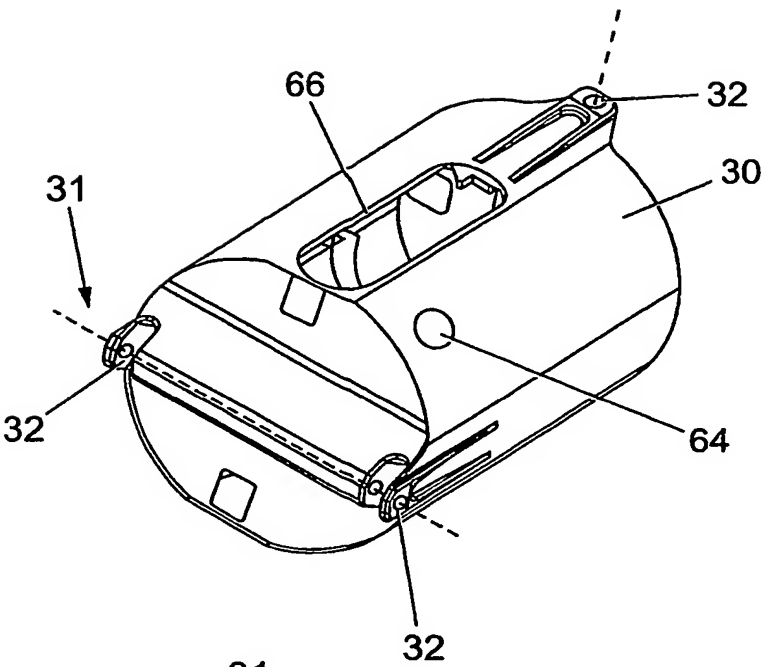


Fig. 7

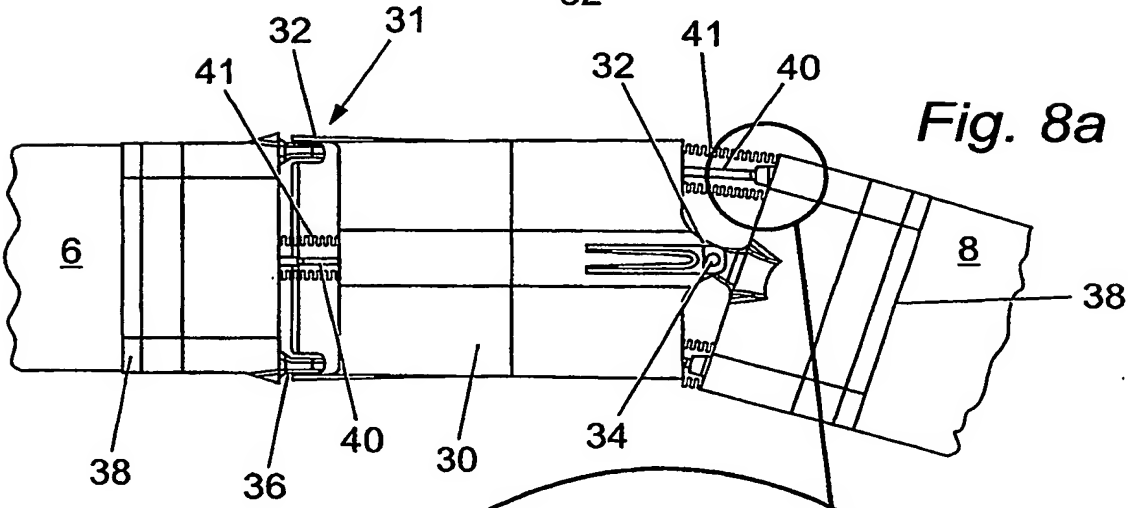


Fig. 8a

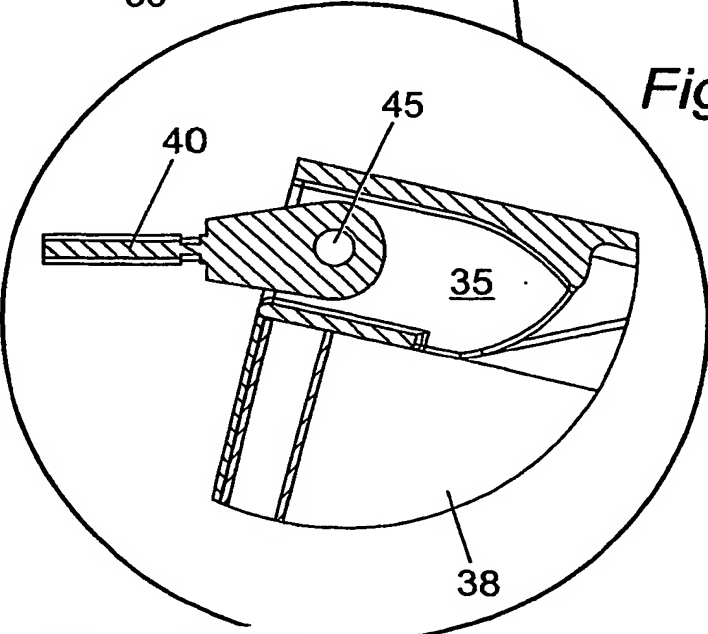


Fig. 8b

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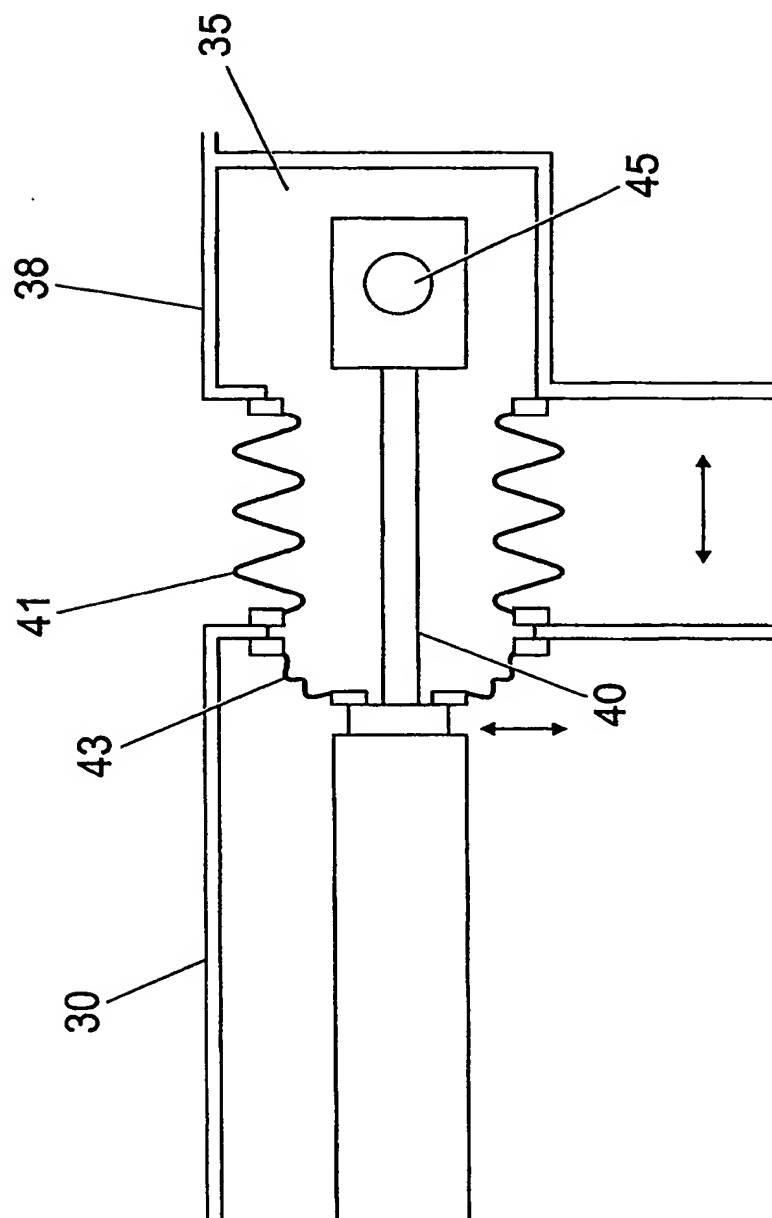


Fig. 8c